



# Current status report in KEK/CFF

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**2020/Oct./21**

**AWLC2020**

# Current activities at KEK/CFF

Cavity Fabrication Facility (CFF) at KEK is currently;

- Working for cost reduction on cavity fabrication
  - Reduce the cost for material: Large grain (LG) Nb
  - Reduce the cost for fabrication
- Working for high pressure gas safety act (He-tank of cavity)
  - Step1. Pre-application for evaluation criterion
  - Step2. Application for equipment test
- Collaborating with other lab and company
  - Inner welding of cavity (with CERN and TECHMETA)
  - Challenge of new technologies

# Main equipment in CFF



Electron beam welding machine (SST, Germany)



Servo press machine (AMADA, Japan)



Microscope



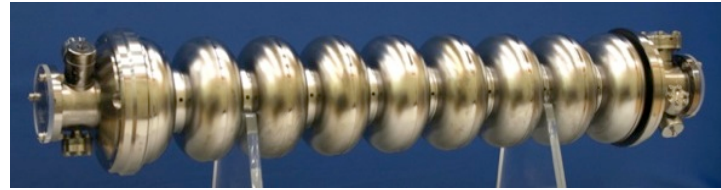
Chemical polishing



CNC vertical lathe (Moriseiki, Japan)

A cavity can be fabricated in KEK site.

# History of CFF

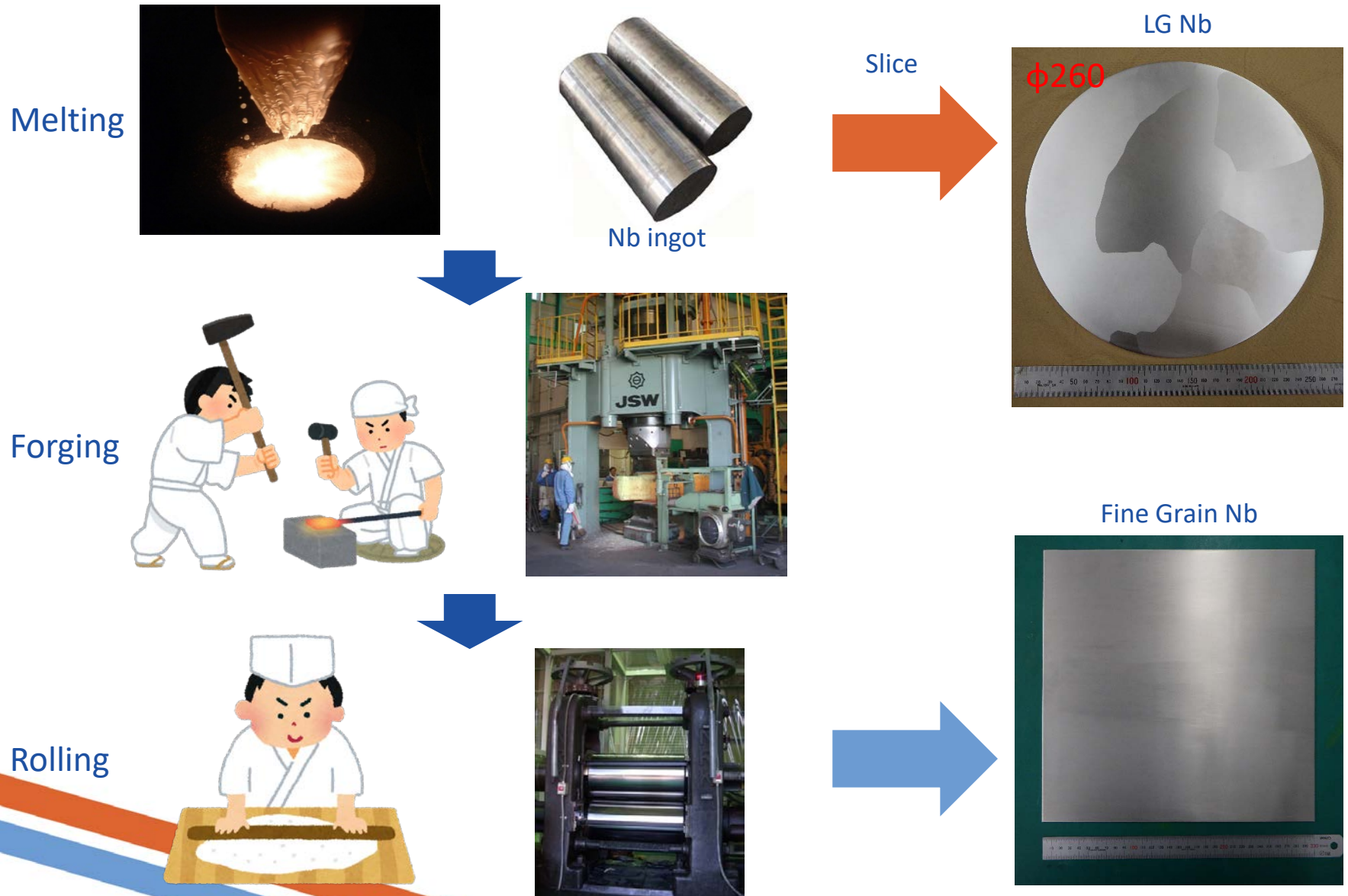


5 × 9-cell cavities, 5 × 3-cell cavity, 10 × 1-cell cavities  
(& some seamless cavities)



# Working on LG niobium

# LG niobium production



Forging and rolling steps can be skipped for LG Nb production.

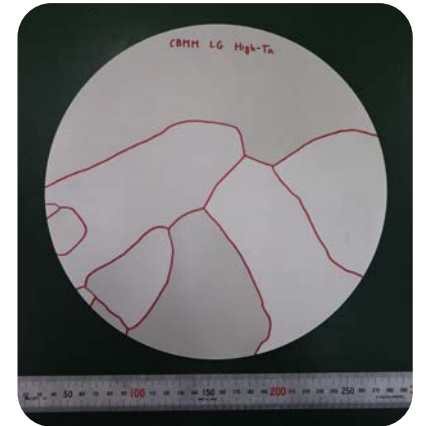
Large cost reduction is expected using LG Nb.

# Current activities on LG niobium



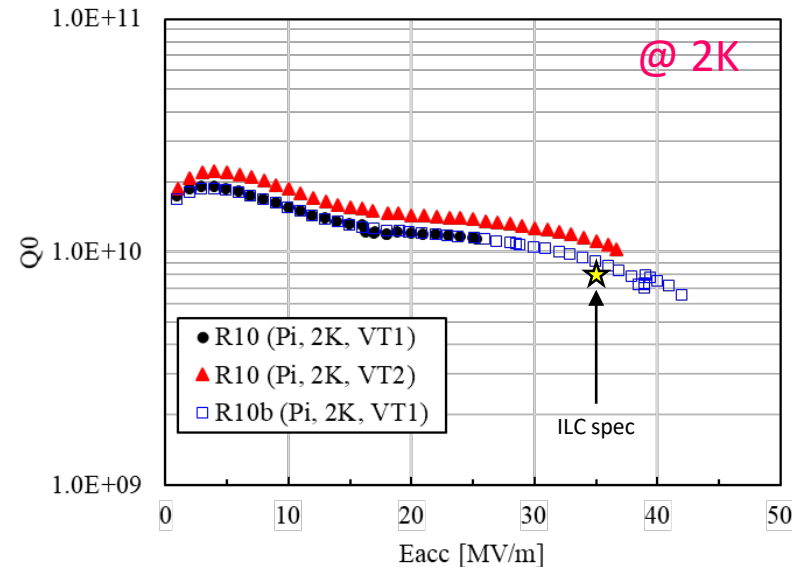
Two 3-cell cavities were made using CBMM LG Nb.

- ✓  $RRR(\rho(300K)/\rho(Tc)) = 242-298$
- ✓ High Ta contained (1034ppm)



## 【Surface treatment】

1. EP1: 100 $\mu$ m
2. Annealing 800 $^{\circ}$ C  $\times$  3hrs
3. Tuning
4. EP2: 20-30 $\mu$ m
5. Baking 120 $^{\circ}$ C  $\times$  48hrs



Two 3-cell cavities satisfied ILC spec.



Two 9-cell cavities were fabricated using same material.

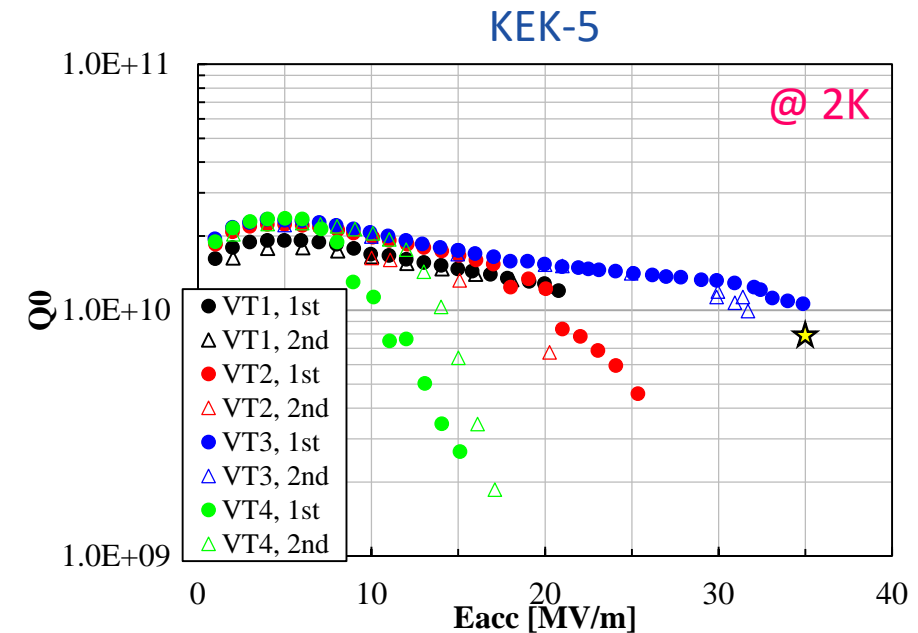
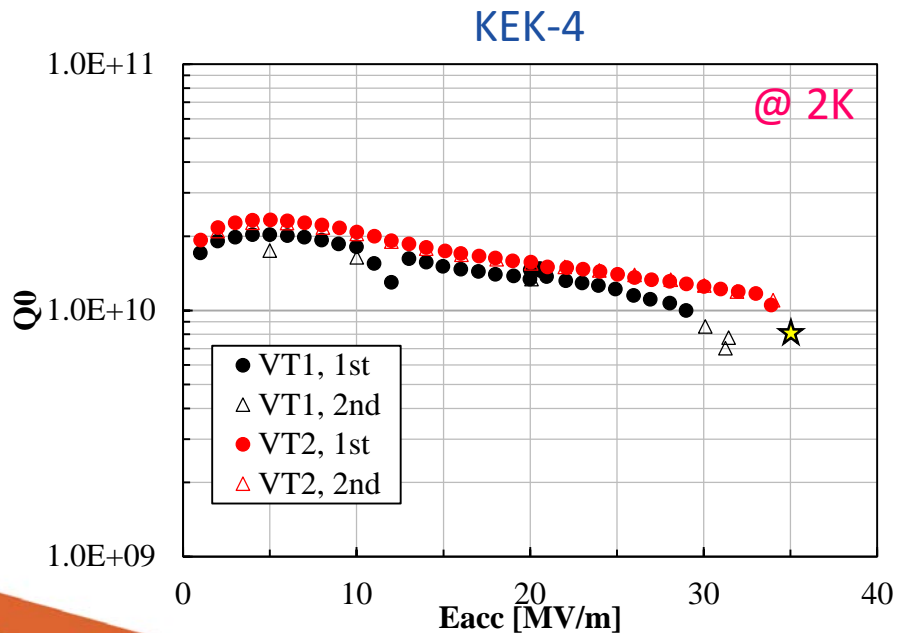
# 9-cell cavity made by LG niobium



Two 9-cell cavities were fabricated using same LG Nb as previous page (CBMM mid-RRR, hi-Ta contained).



Two of them have not achieved ILC spec.





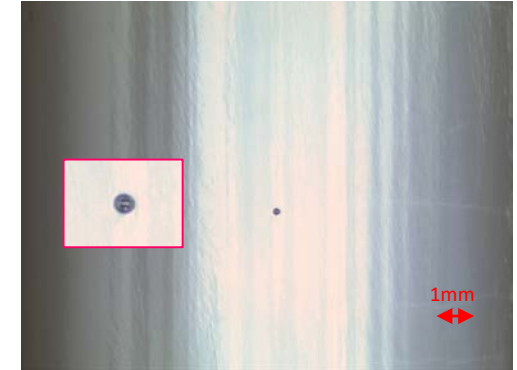
# Summary of LG 9-cell cavity test

KEK-4	$E_{acc}$	Reason
VT1	31.5 MV/m	Quench by the defect
VT2	34 MV/m	Quench (no defects were found)

KEK-5	$E_{acc}$	Reason
VT1	20 MV/m	Quench by the defect
VT2	25 MV/m	Power limitation due to heavy x-ray radiation
VT3	32 MV/m	Quench by the defect
VT4	17 MV/m	Power limitation due to heavy x-ray radiation

- If any defects are found near the quench position, they are removed by local grinding. Then, measurement is done after 20-30 $\mu$ m EP.

Defect found near the quench position of VT1 (KEK-4)



New grinding machine is investigated to remove above defect



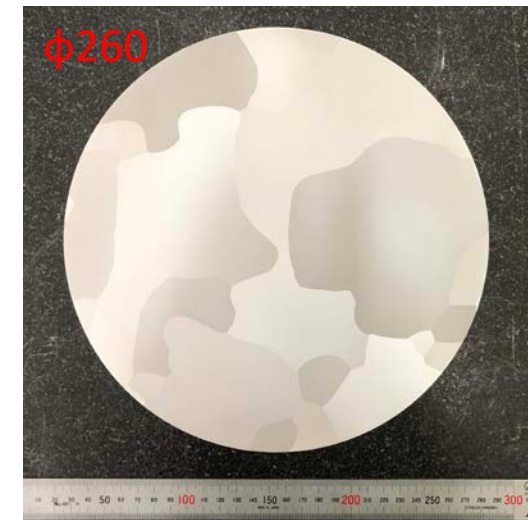
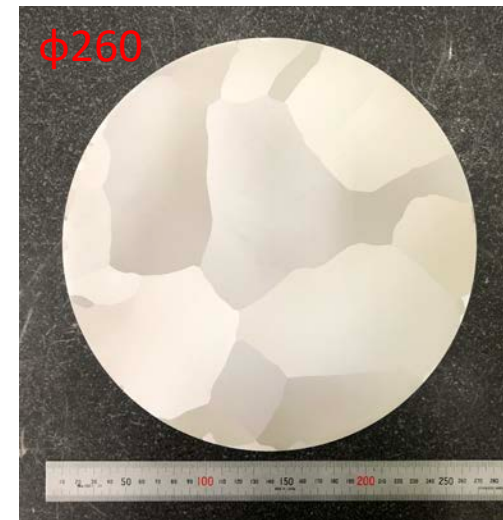
# New LG niobium is ready from ULVAC

ULVAC enabled to produce  $\phi 300$  ingot.

ULVAC



- Two ingots made by different Nb sources were delivered.
- Sliced by Japanese company.
- Four 3-cell cavities made by each ingot will be fabricated in KEK soon.



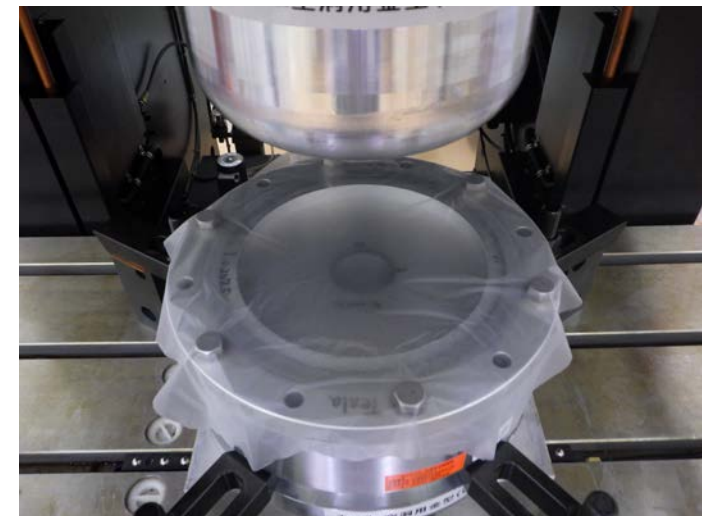
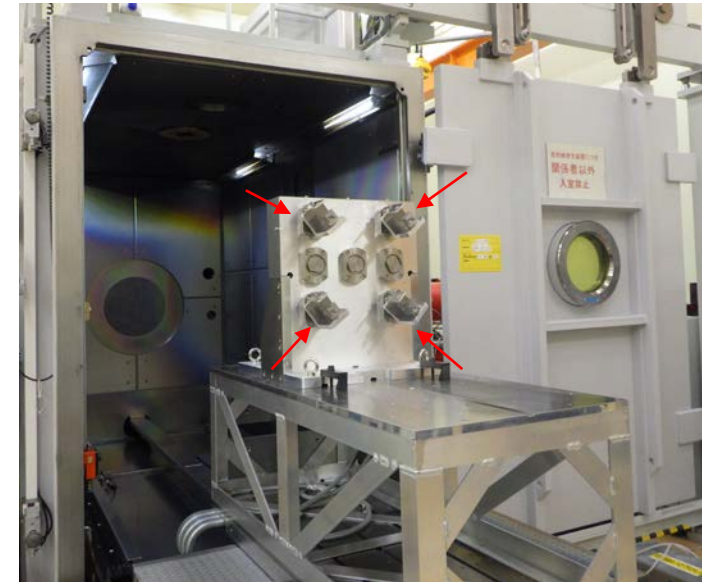
# Investigation on fabrication technique

# Investigation on fabrication techniques

- Multi welding tool  
Multi welding device which enables four welding at one vacuum was investigated.
- Using thin film for press-forming  
Very thin and stretch polyurethane film (30 $\mu$ m) is now used for press-forming to avoid scratches. This film realize oil-less forming. (less time-consuming)



Target: Mass production





# High pressure gas safety act

# Japanese High-Pressure Gas safety act

If we use the cavities in accelerators in Japan, vendors must fabricate cavities complying with **Japanese High-Pressure Gas (J-HPG) safety act**.

KEK should guide foreign vendors for the procedures of J-HPG safety act.



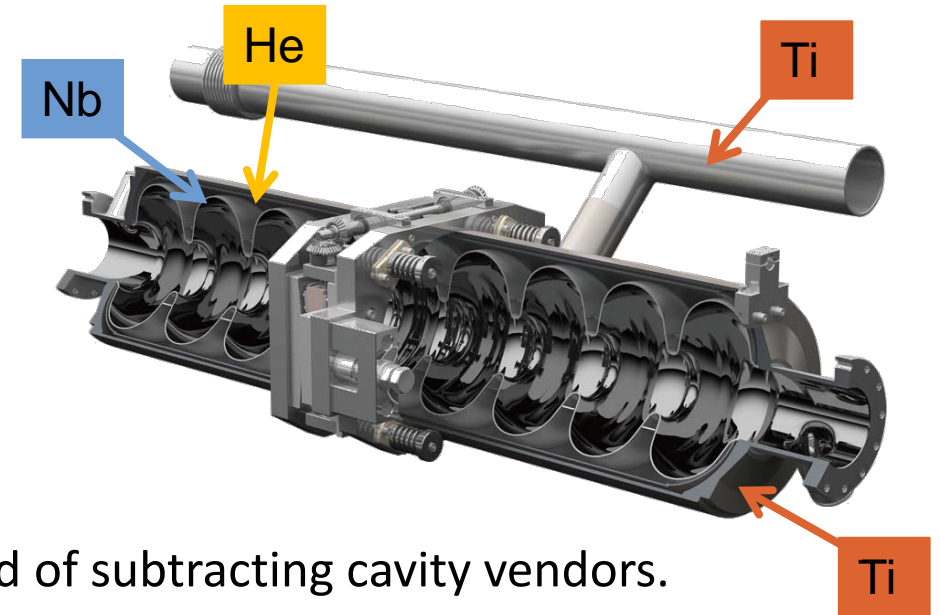
CFF is learning the procedure to pass J-HPG safety act, instead of subtracting cavity vendors.

## Step1. Pre-application for evaluation criterion; **done** ✓

Mechanical property value of Nb, cavity design, stress simulation of cavity, buckling simulation of cavity, etc. are necessary to define evaluation criterion

## Step2. Application for equipment test

Welding Procedure Specification (partially done),  
Thickness measurement, pressure test, leak test, etc.



# Collaboration activity

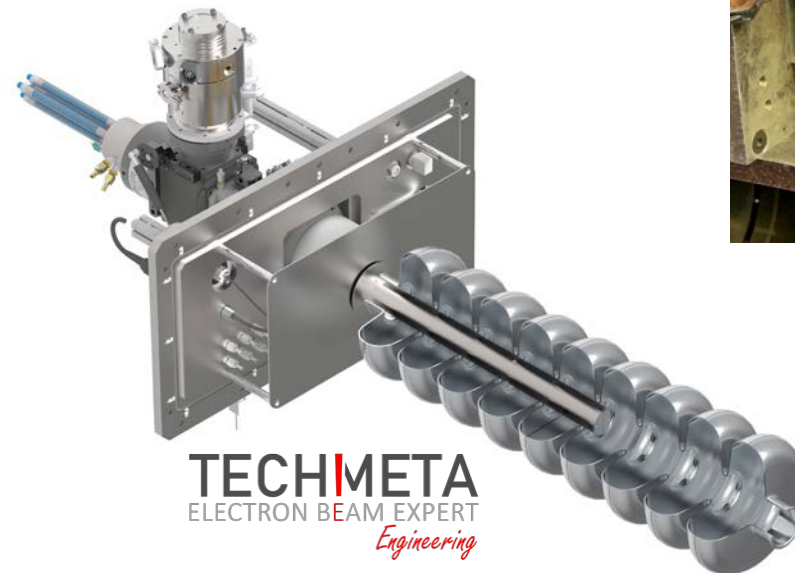
# Collaboration activities (pick up)

Deflector nozzle for electron beam welding are investigated at TECHMETA (France EBW machine company) and CERN respectively. This nozzle enables inside welding of cavity at equator and iris.

TECHMETA and CERN fabricate single cell cavity with their nozzle.  
KEK also fabricate one by typical procedure.



Three cavities will be surface treated and vertical tested at KEK.





# Summary

Cavity Fabrication Facility (CFF) at KEK is currently;

- Working for cost reduction on cavity fabrication
  - Reduce the cost for material: Large grain (LG)
    - Two 9-cell cavities were fabricated using mid-RRR and hi Ta contained LG Nb by CBMM
    - Both of them have not achieved ILC spec.
  - Reduce the cost for fabrication
    - New device and tooling are investigated for mass production
- Working for high pressure gas safety act (He-tank of cavity)
  - Pre-application for evaluation criterion **done**
- Collaborating with other lab and company
  - Inner welding of cavity (with CERN and TECHMETA)
    - Three single-cell cavities are now under fabrication with different welding machines.
    - They will be surface treated and measured at KEK.